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U. S. DEPARTMENT OF AGRICULTURE.  
DIVISION OF VEGETABLE PATHOLOGY.

CIRCULAR No. 10.

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TREATMENT OF NURSERY STOCK

FOR

LEAF-BLIGHT AND POWDERY MILDEW,

BY

B. T. GALLOWAY.

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## LETTER OF SUBMITTAL.

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SIR: I have the honor to submit herewith a circular on the treatment of nursery stock for leaf-blight and powdery mildew. For many years these diseases have been the bane of nurserymen, but it is believed now that by judicious treatment they can be largely prevented.

Respectfully,

B. T. GALLOWAY,  
*Chief of Division.*

Hon. J. M. RUSK,  
*Secretary.*

# TREATMENT OF NURSERY STOCK FOR LEAF-BLIGHT AND POWDERY MILDEW.

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By B. T. GALLOWAY.

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## INTRODUCTORY.

Nurserymen need not be told of the vast amount of injury occasioned every year by leaf-blight and powdery mildew. For the past 2 years a series of experiments has been carried on by this Department with a view of obtaining some light on the treatment of these maladies. The experiments have proved conclusively that powdery mildew of the apple, leaf-blight of the pear, plum, cherry, and quince can readily be controlled at comparatively little expense.

What is stated in this circular is based upon the work referred to above. Future experiments will no doubt necessitate changes in these statements, but it is hoped that the information here given will be of value. In concluding these introductory remarks it may not be out of place to say that no possible injury to stock can follow the use of the remedies, providing, of course, that the directions are carefully followed. No less than ten million young trees of apple, pear, plum, cherry, and quince will be treated the coming season in accordance with the directions herein set forth. This in itself is sufficient evidence of the value of the treatments, which are briefly described in this circular.

## FUNGICIDES USED IN THE WORK.

Bordeaux mixture and the ammoniacal solution are the only fungicides now used in this work. In the nursery our usual plan of making these fungicides is as follows:

*Bordeaux mixture.*—Dissolve 12 pounds of powdered sulphate of copper or bluestone in 15 or 20 gallons of water, using a half barrel or tub for the purpose. In another similar vessel make a milk of lime by stirring up 8 pounds of either unslaked or air slaked lime in 10 or 12 gallons of water. When the milk of lime is ready mix it with the copper solution in the following manner:

First pour the copper solution into a barrel having a capacity of at least 45 gallons; then slowly add the whitewash, pouring this through a piece of coarse sacking, in order to remove bits of stone, wood, etc. Finally fill the barrel with water, stir thoroughly and apply as directed below.

*Ammoniacal solution.*—In an ordinary water pail dissolve 5 ounces of carbonate of copper in 3 pints of aqua ammonia having a strength of 26 per cent. When completely dissolved, pour the fluid into a barrel holding 45 gallons, and fill the latter with water. If desirable the concentrated solution may be prepared in advance and taken into the field in this form. When this plan is followed the liquid should be kept in tightly corked jugs. In using the solution prepared in this way it will only be necessary to measure out 3 pints, pour this into a barrel, and fill the latter with water.

#### TREATMENTS.

*Apple powdery mildew.*—The most serious injury to the seedling, caused by this disease, is the loss of its foliage. To prevent this, and thereby insure good working stocks for buds, spray the seedlings with the ammoniacal solution, first when the leaves are about half grown and thereafter at intervals of 12 days. Following this plan, three sprayings will usually be made before budding and at least two after this operation, making five in all. It is seldom that powdery mildew proves serious to budded or grafted stock with the exception of certain particularly susceptible varieties. In such cases practically the same line of treatment recommended for the seedlings may be followed.

*Pear-leaf blight.*—Nearly all varieties of the pear are subject to this disease, which attacks the young and tender seedlings as well as old fruit-bearing trees. In the nursery the seedlings must be protected, otherwise the leaves will drop by the first of July and it will be next to impossible to work the stocks. Beginning then with the seedlings, we would recommend that they be sprayed with the Bordeaux mixture first when the foliage is half grown, and thereafter as recommended for apple-powdery mildew, excepting an additional treatment after the buds are inserted, making six in all. The next season, as soon as growth starts, begin the spraying again, making six applications during the growing period. This should be kept up as long as the tree stands in the nursery, after which the orchardist, if he wishes to succeed with it, must follow a similar plan. It may occur to some that so much additional labor upon a tree will not pay. Careful estimates show, however, that it does pay. But this side of the question will be more fully discussed under cost of treatment.

*Plum, cherry, and quince leaf-blight.*—The directions for treating pear leaf-blight are applicable to all of these diseases. While, however, the Bordeaux mixture has certainly given the best results in treating the

last-named disease in the nursery, it is questionable whether for the plum, cherry, and quince the ammoniacal solution will not answer as well. We have never been able to see any material difference, so far as effectiveness is concerned, between these preparations. The ammoniacal solution is cheaper and more easily prepared and applied. Such being the case, it would probably be best to use it.

#### APPLYING THE REMEDIES.

Much of the success or failure of the work will depend on the manner in which the fungicides are applied. With suitable spraying pumps and nozzles the work is not tedious nor difficult. In nearly all of our work the knapsack sprayers have been used, and, while we are satisfied that the treatments can be carried on in a paying manner with these, we believe that machines can be devised that will do the work much more rapidly, if not quite as effectively. The knapsack pumps are now being manufactured and sold by numerous firms throughout the country who make a specialty of fungicide and insecticide machinery. In all cases where a knapsack pump is used, or any pump for that matter, the improved Vermorel nozzle\* (Figure 1) will be found one of the most effective instruments for making the spray. One of the special advantages of this nozzle is that it does not clog. Knapsack pumps provided with Vermorel nozzles complete, and of the best quality, are now on the market at \$14 each. For spraying seedling and yearling apples it is

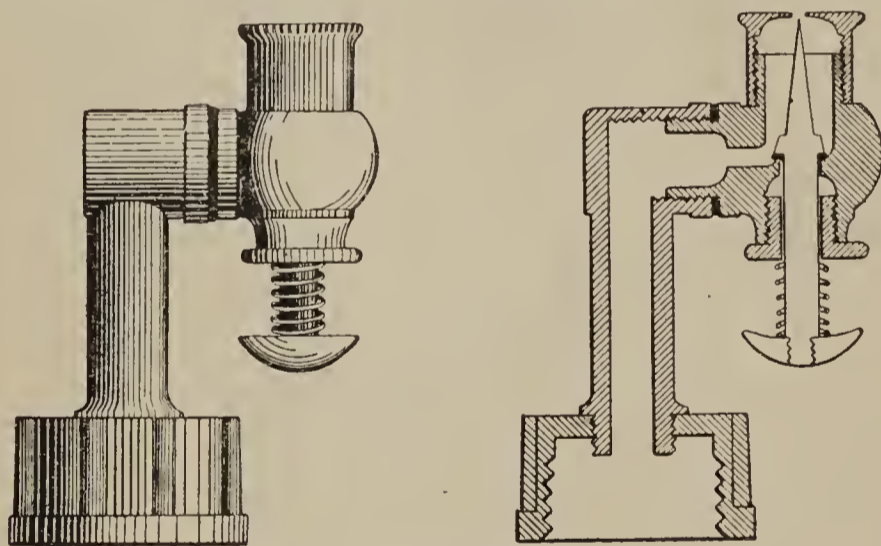


FIG. 1.—Half natural size.

safe to estimate one knapsack pump for every 500,000 trees; that is, working every day it will take one man, on an average, 12 days to get over a block, or several blocks, of seedlings or yearlings, aggregating a half million trees. From these figures it is possible to get a fair idea of the number of men and machines required to do a certain amount of work. The amount of work, of course, will vary directly as the amount of leaf surface, so that if 1,000 or 10,000 pears, cherries, or other trees have twice the leaf surface of an ordinary seedling or yearling apple it will require twice the work to spray them.

\* For attaching this nozzle to the pump shown at figure 3 a  $\frac{1}{4}$ -inch coupling is required.

Last year we devised a machine which with two men and a horse did the work of 4 Knapsack pumps. This apparatus is shown complete in Figure 2.

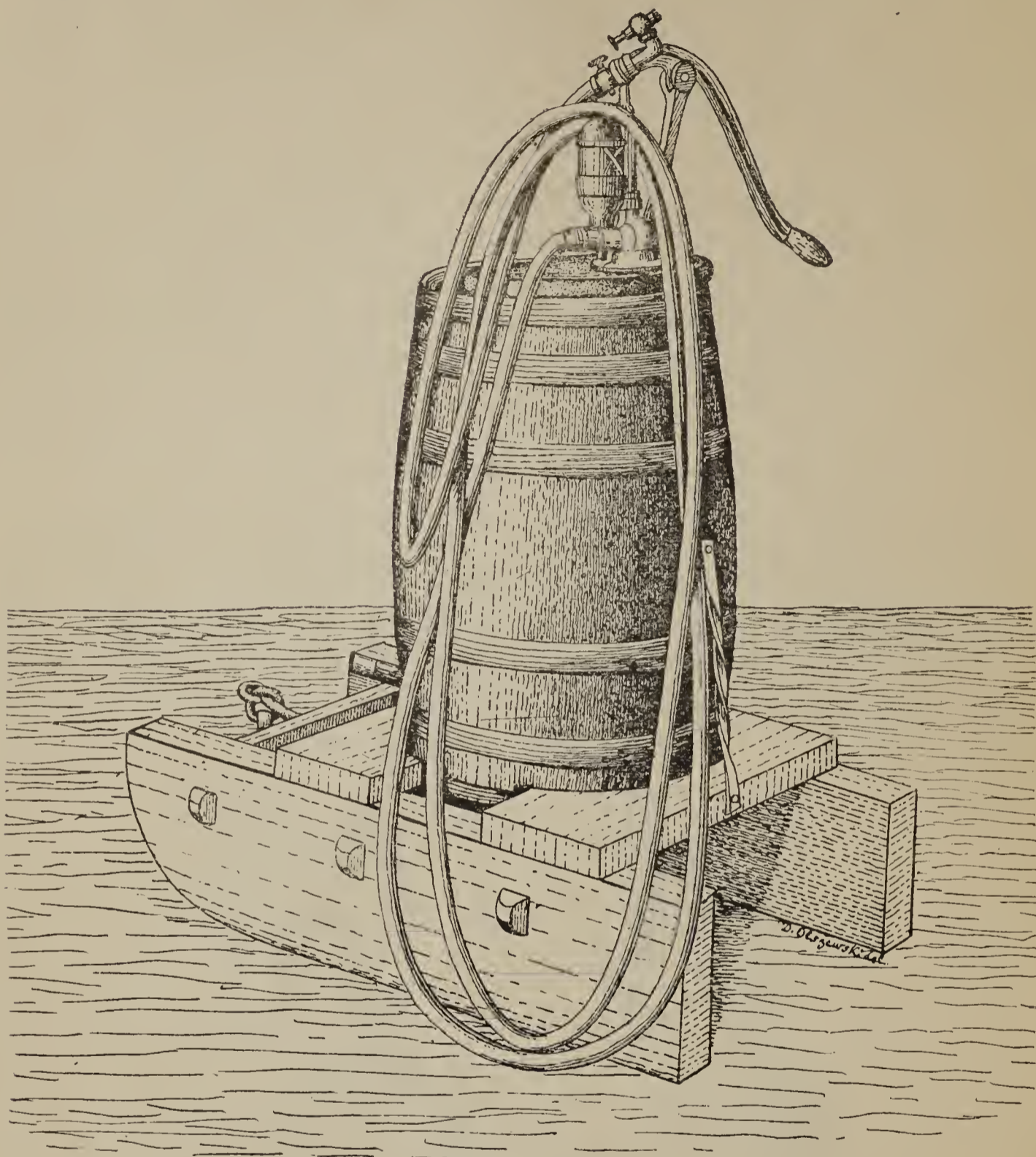


FIGURE 2.

It consists, as will be seen, of the following parts: One Nixon Climax pump, No. 2, 20 feet of  $\frac{1}{2}$ -inch hose, 1 sled, 1 half barrel, and 1 improved Vermorel nozzle.

The figure shows how these are put together, so that nothing further need be said on this point. We would, in this connection, however, call attention to Figure 3 illustrating the style of machine we shall use the coming season for this work. The pump in this case is also a Nixon, and is designed especially for mounting on a barrel. It is provided with two discharge hose, making it possible to spray four rows at a time. In case both hose are used it will be an easy matter to rig up an arm to carry one hose over the tops of the trees into the row ad-



jaacent to the one in which the machine is running. To enable each man to spray two rows conveniently and without loss of time and fluid it would probably be well to use four nozzles. This may be arranged by means of a Y having the perpendicular arm provided with a  $\frac{1}{2}$ -inch female screw-thread for attaching to the hose. Two pieces of  $\frac{1}{4}$ -inch cloth insertion hose, each 3 feet long, can be fastened to the short arms of the Y by simply wiring them on, thus effectually dividing the stream. The nozzles being attached to the free ends of the  $\frac{1}{4}$ -inch hose enables the operator to spray two rows without difficulty, whether they be  $2\frac{1}{2}$ , 3, 4, or even 5 feet apart. In using this apparatus three men will be required, one to drive and pump and two to manage the nozzles. The machine operated in this way will certainly do the work of 5 Knapsack pumps.

We have found it very difficult to do good work in this way if the horse is kept constantly on the move. For this reason we have adopted the following plan :

Each piece of hose is 25 feet long, which gives the operator full control over at least 20 feet resting upon the ground. In beginning work, the horse is driven into the row 20 feet and stopped. The pump is then worked and the spraying immediately begins. When the sprayers have traversed 16 or 18 feet, spraying two rows as they advance, the horse is started again and stopped once more after covering 20 feet. In the meantime the pump has not stopped, except for a moment, and no break at all has occurred in the spray. A horse or mule soon learns to stop at the proper time, so the driver can give practically all of his attention to the pump. Working in this way, the spray is applied rapidly and thoroughly, and what is more important, without waste of time and fluid.

The cost of such a machine is approximately as follows :

1 Nixon barrel pump and 50 feet of hose .....	\$20.00
1 half barrel.....	1.00
1 sled.....	2.50
2 Vermorel nozzles, at \$1.50 each.....	3.00
Total.....	<u>26.50</u>

#### COST OF THE TREATMENTS.

Careful estimates show that the total cost of treating apple seedlings five times with the ammoniacal solution, as already discussed, need not exceed 8 cents per thousand. These figures are not based upon a small experiment; on the contrary, they were obtained by treating at one time and in one nursery, 400,000 trees. Pear, plum, cherry, and quince stocks can be treated six times the first season with the Bordeaux mixture for 55 cents per thousand. If the ammoniacal solution is used the cost of treating the plum, cherry, and quince need not exceed 12 cents per thousand trees. What has already been said in regard to the amount of fluid necessary is applicable here; that is, the amount of

fluid required and the labor necessary will be directly in proportion to the amount of foliage.

The foregoing estimates are in all cases based on the fact that the chemicals and labor costs as follows :

	Cents.
Copper sulphate, powdered..... per pound..	8
Lime..... per bushel..	30
Copper carbonate..... per pound..	40
Aqua ammonia 26°..... do.....	8
Labor..... per hour..	10

#### FINAL SUGGESTION.

Work of this kind to be successful must, like everything else, be done in a thorough manner. In no case should the first treatment be delayed beyond the period mentioned, namely, when the leaves are half grown. If delayed until the diseases have appeared to a damaging extent there will be little benefit derived from any applications that may be made. Early treatments, careful application of the fungicides so as to reach every leaf, and vigilance in the matter of repeating the treatments at least every 12 days are the most important points to keep in mind.



FIGURE 3.